Reduce Space Conditioning during Non-Working Hours (Arc 2.7224)

(The analysis below was extracted from one of the assessment reports by the Clemson University Industrial Assessment Center (IAC). This is only an example recommendation and hence, not all the background information and sources for numbers are included here.)

Est. Electric Consumption Savings	= ***203,500 kWh/yr***
Est. Electric Consumption Cost Savings	= ***$13,024/yr***
Est. Implementation Cost	= ***$250/yr***
Simple Payback Period	= ***0.23 months***

Recommended Action:
It is recommended to adjust programmable thermostats to 73°F during operating hours and 81°F at night throughout the plant to avoid over-conditioning the space when unoccupied.

Background:
The two buildings in the plant are currently consistently conditioned at the range of 70-71°F, and temperatures do not change throughout the day or year. The HVAC systems run 24/7 and conditioning continues when spaces are no longer occupied. The U.S. Department of Energy predicts that plants can save about 5% to 15% of HVAC energy by setting the thermostat to use less cooling for 8 hours outside of occupation hours, and that up to 1% energy can be saved for each degree Fahrenheit during the 8-hour period [1]. This prediction was used to approximate the cost savings in the following section. The plant operates 2000 hours per year and is charged $0.064/kWh for electric consumption and $14.91/kW for electric demand.

Anticipated Savings:
Using the U.S. Department of Energy estimated savings per degree Fahrenheit during an 8-hour period and annual electricity consumption of the plant, we can estimate the savings due to setting back the thermostats. The average range of the temperature throughout the year is 70-71°F. First, it is recommended to set all the thermostats at 73°F during the working hours to reduce the overcooling by 2°F. Second, during the night hours where the buildings are unoccupied, it is recommended to setback all thermostats at 81°F which reduces the overcooling by 8°F approximately. Note that we suggest setting the thermostats at 81°F instead of turning them off during the unoccupied hours. It usually takes few hours to regulate the temperature back to normal working levels throughout the facility if the HVAC systems are completely off and it may cause discomfort among the personnel. However, depending on the occupancy and working hours of different areas around the facility, the management may decide to turn off the thermostats in some specific areas. By turning off or setting back the temperature outside of operation hours significant additional savings can be achieved.

The estimated *unit electricity consumption saving* per degree Fahrenheit annually can be determined as follows:

$$Unit\ Electricity\ Consumption\ Savings\ (UECS = \frac{1\% \times\ Annual\ Electricity\ Consumption}{°F}$$

$$\boldsymbol{UECS = 0.01 \times 2{,}035{,}000\ \frac{kWh}{°F} = 20{,}350\ \frac{kWh}{°F}}$$

The annual *electricity consumption saving* for setting back the thermostats during the working hours and during the nights can be calculated as follows

$$\textit{Electrical consumption saving (ECS)} = \textit{UECS} \times \textit{(Setback 1 + Setback 2)}$$

$$\boldsymbol{ECS = 20{,}350\ \frac{kWh}{°F} \times (2\ °F + 8\ °F) = 203{,}500\ kWh}$$

Finally, the estimated annual electric consumption cost savings can be determined based on the unit electricity consumption charge as

$$\textit{Electric consumption cost savings (ECCS)} = \textit{ECS} \times \left(\frac{\$0.064}{kWh}\right)$$

$$\boldsymbol{ECCS = 203{,}500\ kWh \times \left(\frac{\$0.064}{kWh}\right) = \$13{,}024/yr.}$$

Implementation Cost:

If the facility does not have programmable thermostats, there will be an implementation cost associated with this recommendation. The implementation cost will directly reflect paying a worker to change the settings on all the thermostats that assist in heating and cooling the areas. The *implementation cost, IC*¸ would be approximately $250 per year.

$$\boldsymbol{Implementation\ cost\ (IC) = \frac{\$250}{year}}$$

Simple Payback Period:

The *simple payback period, SPP*, is the time required to pass before the estimated total cost savings equal the estimated implementation cost, and is calculated by:

$$SPP = \frac{IC}{TCS} \times \frac{12\ months}{yr}$$

$$SPP = \frac{\$250}{\$13{,}024/yr} \times \frac{12\ months}{yr}$$

$$\boldsymbol{SPP = 0.23\ months}$$

References:

[1] Program Your Thermostat for Fall and Winter Savings. U.S. DOE. *https://energy.gov/energysaver/articles/program-your-thermostat-fall-and-winter-savings* (accessed August 2018).